CLAIMS

I claim:

1. A method for subtracting fixed pattern noise in a digital imaging system incorporating a digital image sensor, comprising:

acquiring a frame of pixel data;

for each pixel in the frame, calculating a predicted pixel value based on the pixel data of a neighborhood of pixels surrounding the pixel and using one or more pixel value prediction algorithms;

for each pixel in the frame, calculating a predicted noise value using the predicted pixel value and the pixel data for the pixel;

calculating a confidence estimate for each predicted pixel value;

calculating a fixed pattern noise estimate for each pixel using the predicted noise value and the confidence estimate, wherein the confidence estimate determines the amount of predicted noise value to be incorporated into the fixed pattern noise estimate for the pixel;

temporally filtering the fixed pattern noise estimate; and

subtracting the fixed pattern noise estimate for each pixel from the frame of pixel data to generate a final image.

2. The method of claim 1, wherein calculating a fixed pattern noise estimate for each pixel using the predicted noise value and the confidence estimate comprises:

comparing the confidence estimate for the pixel to a predetermined threshold;

if the confidence estimate for the pixel is less than the predetermined threshold, calculating the fixed pattern noise estimate without incorporating the predicted noise value; and

if the confidence estimate for the pixel is greater than the predetermined threshold, calculating the fixed pattern noise estimate by incorporating the predicted noise value.

3. The method of claim 1, wherein calculating a fixed pattern noise estimate for each pixel using the predicted noise value and the confidence estimate comprises:

calculating a weight factor proportional to the confidence estimate; and

calculating the fixed pattern noise estimate by incorporating the predicted noise value and weighing the predicted noise value using the weight factor.

4. The method of claim 1, wherein calculating a predicted pixel value based on the pixel data of a neighborhood of pixels surrounding the pixel and using one or more pixel value prediction algorithms comprises using one or more pixel value prediction algorithms selected from the group of interpolation, medial filtering, interpolation using a weighted average, a contrast estimator, and a high frequency texture detector based on a discrete transform algorithm.

5. The method of claim 4 wherein the discrete transform algorithm comprises a DCT (Discrete Cosine Transform) algorithm or a FFT (Fast Fourier Transform) algorithm.

6. The method of claim 1, wherein calculating a predicted noise value using the predicted pixel value and the pixel data for the pixel comprises:

calculating a difference between the predicted pixel value and the pixel data for the pixel, the difference being the predicted noise value.

7. The method of claim 1, wherein calculating a confidence estimate for each predicted pixel value comprises:

determining the nature of the image at the neighborhood of pixels used to calculate the predicted pixel value.

8. The method of claim 7, wherein determining the nature of the image at the neighborhood of pixels comprises:

measuring the contrast of the image at the neighborhood of pixels, wherein when the contrast is high, the confidence estimate has a low value and when the contrast is low, the confidence estimate has a high value.

9. The method of claim 7, wherein determining the nature of the image at the neighborhood of pixels comprises:

measuring the high frequency content of the image at the neighborhood of pixels, wherein when the neighborhood of pixels includes high frequency content, the confidence estimate has a low value and when the neighborhood of pixels does not include high frequency content, the confidence estimate has a high value.

10. The method of claim 7, wherein determining the nature of the image at the neighborhood of pixels comprises:

measuring the smoothness of the image at the neighborhood of pixels, wherein when the smoothness is low,

the confidence estimate has a low value and when the smoothness is high, the confidence estimate has a high value.

11. The method of claim 1, wherein temporally filtering the fixed pattern noise estimate comprises applying a temporal filter to the fixed pattern noise estimate.

12. A method for subtracting fixed pattern noise in a digital imaging system incorporating a digital image sensor, comprising:

acquiring a reference noise image of a homogeneous, smooth surface;

acquiring a frame of pixel data;

selecting a prediction area within the frame of pixel data;

for each pixel in the prediction area, calculating a predicted pixel value based on the pixel data of a neighborhood of pixels surrounding the pixel and using one or more pixel value prediction algorithms;

for each pixel in the prediction area, calculating a predicted noise value using the predicted pixel value and the pixel data for the pixel;

calculating a confidence estimate for each predicted pixel value;

calculating a prediction area noise estimate for each pixel in the prediction area using the predicted noise value and the confidence estimate, wherein the confidence estimate determines the amount of predicted noise value to be incorporated into the prediction area noise estimate for the pixel;

temporally filtering the prediction area noise estimate for each pixel in the prediction area;

calculating scaling parameters for a fixed pattern noise estimate of the frame of pixel data using the prediction area noise estimate and the reference noise image;

calculating the fixed pattern noise estimate for the frame of pixel data using the scaling parameters and the reference noise image; and

subtracting the fixed pattern noise estimate for each pixel from the frame of pixel data to generate a final image.

13. The method of claim 12, wherein calculating scaling parameters for a fixed pattern noise estimate of the frame of pixel data using the prediction area noise estimate and the reference noise image comprises:

modeling the prediction area noise estimate as $\chi \cong m * \delta_\Omega + \varepsilon$, where m and ε are the scaling parameters, and δ_Ω represents the pixel data for the reference noise image in the prediction area; and

determining values of the scaling parameters m and ε using a least square error fit of the reference noise image δ_Ω to the prediction area noise estimate χ for all the pixels in the prediction area.

14. The method of claim 12, wherein calculating the fixed pattern noise estimate for the frame of pixel data using the scaling parameters and the reference noise image comprises:

calculating the fixed pattern noise estimate χ' using the equation $\chi'=m*\delta+\varepsilon$, where δ represents the pixel data of the reference noise image of the frame of pixel data.

15. The method of claim 12, wherein calculating a prediction area noise estimate for each pixel in the prediction area using the predicted noise value and the confidence estimate comprises:

comparing the confidence estimate for the pixel to a predetermined threshold;

if the confidence estimate for the pixel is less than the predetermined threshold, calculating the prediction area noise estimate without incorporating the predicted noise value; and

if the confidence estimate for the pixel is greater than the predetermined threshold, calculating the prediction area noise estimate by incorporating the predicted noise value.

16. The method of claim 12, wherein calculating a prediction area noise estimate for each pixel in the prediction area using the predicted noise value and the confidence estimate comprises:

calculating a weight factor proportional to the confidence estimate; and

calculating the prediction area noise estimate by weighing the predicted noise value using the weight factor.

17. The method of claim 12, wherein calculating a predicted pixel value based on the pixel data of a neighborhood of pixels surrounding the pixel and using one or more pixel value

prediction algorithms comprises using one or more pixel value prediction algorithms selected from the group of interpolation, medial filtering, interpolation using a weighted average, a contrast estimator, and a high frequency/texture detector based on a DCT/FFT (Discrete Cosine Transform/Fast Fourier Transform) algorithm.

18. The method of claim 12, wherein calculating a confidence estimate for each predicted pixel value comprises:

determining the nature of the image at the neighborhood of pixels used to calculate the predicted pixel value.

19. The method of claim 18, wherein determining the nature of the image at the neighborhood of pixels comprises:

measuring the contrast of the image at the neighborhood of pixels, wherein when the contrast is high, the confidence estimate has a low value and when the contrast is low, the confidence estimate has a high value.

20. The method of claim 18, wherein determining the nature of the image at the neighborhood of pixels comprises:

measuring the high frequency content of the image at the neighborhood of pixels, wherein when the neighborhood of pixels includes high frequency content, the confidence estimate has a low value and when the neighborhood of pixels does not include high frequency content, the confidence estimate has a high value.

21. The method of claim 18, wherein determining the nature of the image at the neighborhood of pixels comprises:

measuring the smoothness of the image at the neighborhood of pixels, wherein when the smoothness is low,

the confidence estimate has a low value and when the smoothness is high, the confidence estimate has a high value.